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10/539,254	06/16/2005	Shoji Miyake	123612	2416
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KACKAR, RAM N				
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

# Office Action Summary

**Application No.**

10/539,254

**Applicant(s)**

MIYAKE ET AL.

**Examiner**

Ram N. Kackar

**Art Unit**

1792

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 December 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 5-25 and 27-56 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 5-25 and 27-56 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/S508)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

#### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(c), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(c) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/22/2008 has been entered.

#### ***Drawings***

2. The subject matter of this application admits of illustration by a drawing to facilitate understanding of the invention. Applicant is required to furnish a drawing under 37 CFR 1.81(c). No new matter may be introduced in the required drawing. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d).

Claim 20 recites a capacitor located in proximity to an antenna is disclosed to detect voltage applied to the antenna. This capacitor 45 is not shown on drawing 22. Correction is required.

#### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**4. Claims 5-7, 12-14, 16, 24-25, 27-28, 36-38, 41, 47, 50, 53 and 56 are rejected under 35 U.S.C. 102(b) as anticipated by Yamakoshi et al (US 2001/0021422).**

Yamakoshi et al disclose a plasma generator for a vacuum chamber (Abstract), a stage (Fig 29) to hold a substrate (base plate) and multiple RF antennas attached to sidewalls arranged parallel to the stage through a plate shaped conductor 26a, 26b outside the vacuum chamber ( See for example Fig 29, 30 and paragraph 141). Although the length of conductor is not disclosed it can be fairly estimated from the size of the vacuum housing and the frequency applied ( $13.54 \text{ MHz} - \lambda/4 = 5.5\text{m}$ ) that it is much less than  $\lambda/4$ . The antennas are connected in parallel. Yamakoshi et al further teach phase detectors and phase shifters (phase matcher) and power meters for regulating the phases of RF power supplied to the antennas (electrode) and impedance matching circuits controlled by controller.

In claim 13 regarding the recitation of an impedance element it is noted that even a length of wire is an impedance element especially when power supply frequency in RF is concerned.

**5. Claims 11-16, 27, 32-33, 40-41, 43-44, 46-47, 49-50, 52-53 and 55-56 are rejected under 35 U.S.C. 102(b) as anticipated by Masaji et al (JP 2001-035697).**

Masaji et al disclose a plasma generator for a vacuum chamber (Abstract), a stage (Fig 1-4) to hold a substrate (base plate) and multiple RF antennas attached to sidewalls arranged parallel to the stage (Fig 11). The antennas are connected in parallel. Although the length of conductor is not disclosed it can be fairly estimated from the size of the vacuum housing and the frequency applied ( $13.54 \text{ MHz} - \lambda/4 = 5.5\text{m}$ ) that it is much less than  $\lambda/4$ . The antennas are

connected in parallel and could be coated with an insulator. Also disclosed are impedance elements (11) and (C<sub>b</sub>).

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**7. Claims 5-16, 23-25 and 27-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) in view of Yamakoshi et al (US 2001/0021422).**

Masaji et al disclose a plasma generator for a vacuum chamber (Abstract), a stage (Fig 1-4) to hold a substrate (base plate) and multiple RF antennas attached to sidewalls arranged parallel to the stage (Fig 11). The antennas are connected in parallel. Although the length of conductor is not disclosed it can be fairly estimated from the size of the vacuum housing and the frequency applied (13.54 MHz-  $\lambda/4 = 5.5\text{m}$ ) that it is much less than  $\lambda/4$ . The antennas are connected in parallel and could be coated with an insulator. Also disclosed are impedance elements (11) and (C<sub>b</sub>).

Masaji et al however do not disclose that antennas are connected through a conductive plate.

Yamakoshi et al disclose a plasma generator for a vacuum chamber (Abstract), a stage (Fig 29) to hold a substrate (base plate) and multiple RF antennas attached to sidewalls arranged

parallel to the stage through a plate shaped conductor 26a, 26b outside the vacuum chamber (See for example Fig 29, 30 and paragraph 141).

Since plate like conductors can provide secure connections at required distance (important since that may introduce some phase shift) it would be obvious for one of ordinary skill in the art at the time of invention to use plate like conductors for parallel connections.

Regarding the limitation of aspect ratio of the antenna according to the definition of the aspect ratio in the specification it is clear that aspect ratio determines the projection of the antenna towards the center of the substrate, it is obvious that the RF field (inductive as well as capacitive) will be oriented further in according to this projection. The very fact that Masaji et al disclose multiple antennas is the recognition that antennas have stronger RF fields in their vicinity and by controlling there position spatial distribution of plasma density is controlled.

It is noted that no specific relation ship between aspect ratio and plasma property at a specified target is claimed.

In claim 13 regarding the recitation of an impedance element it is noted that even a length of wire is an impedance element especially when power supply frequency in RF is concerned.

**8. Claims 5-17, 23-25 and 27-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) in view of Minoru Kanda (JP 2002-260899).**

Masaji et al however do not disclose that they are connected through a conductive plate. Minoru Kanda also discloses a plate shaped conductor to connect to antennas.

It would have been obvious for one of ordinary skill in the art at the time of invention to use a conductor plate to connect to antenna elements for convenience and integrity of connection with less loss.

**9. Claims 13-17 and 34-35 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Minoru Kanda (JP 2002-260899) or Majima Hiroshi (JP 2000-058465).**

Masaji et al and Yamakoshi et al are discussed above.

Regarding impedance element it is noted that even a length of wire is an impedance element especially when power supply frequency in RF is concerned.

However, Minoru Kanda discloses discrete impedance elements Fig 1-3, Fig 3-4 and Fig 4-5 for control of power delivered to U shaped antennas. Minoru Kanda also discloses plurality of antennas connected to individual power supplies (abstract and Fig 5).

Similarly Majima Hiroshi et al disclose discrete impedance elements 61a-61g which could be a variable inductance.

Therefore, it would have been obvious for one of ordinary skill in the art at the time of invention to have inserted discrete impedance elements between power supply and antenna to more precisely control power delivered at predetermined phase to each antenna.

**10. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Majima Hiroshi (JP 2000-058465) or Choi et al (US 2002/0023718).**

Masaji et al or Yamakoshi et al do not explicitly disclose that the variable impedance could be a variable inductance coil.

Choi et al and Majima Hiroshi disclose use of both variable capacitor and inductor for impedance matching.

Therefore having a variable inductance coil would have been obvious to one of ordinary skill in the art at the time of invention.

**11. Claims 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Nakamura et al (JP 2001094485).**

Masaji et al or Yamakoshi et al do not disclose pickup coil and bridge rectifier with a capacitor to measure power.

Nakamura et al disclose a pick-up coil and a rectifier to convert to DC disposed proximately to an antenna (Abstract and Fig 3).

Therefore it would have been obvious for one of ordinary skill in the art to measure power in the way taught by Nakamura et al in order to be able to control it precisely in the apparatus of Yamakoshi et al.

**12. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Koji Oku (JP 08162291).**

Masaji et al or Yamakoshi et al do not disclose a mixer for voltage and current signals to measure power.

Koji Oku disclose a high-frequency power source (Fig 1-10) comprising a matching box (30) and a power detection circuit (40), wherein the power detection circuit comprises a low pass filter (47) for conducting frequency mixing in double balanced mixers (46a, b) and removing the high-frequency components from the output of the double balanced mixers using local oscillator (45) and further low pass filter (49). Therefore power detection circuit converts the frequency of the high-frequency power to a low frequency and conducts detection based on the low-frequency power. Further the detected signal is used as negative feedback for control of high frequency power (Abstract and Fig 2).

Therefore it would have been obvious for one of ordinary skill in the art to measure power in the way taught by Koji Oku in order to be able to control it precisely in the apparatus of Yamakoshi et al.

**13. Claims 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Kojin Nakagawa (JP 08325759).**

Yamakoshi et al do not explicitly disclose controlling plasma by regulating antenna length.

Kojin Nakagawa discusses the relationship of length vs. wavelength/frequency and uniformity (Paragraph 7-10 and 34-35).

Therefore regulating the length to get maximum uniformity would be obvious to one of ordinary skill in the art at the time of invention.

**14. Claims 13-16, 18 and 34-35 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Dible et al (US 6042686).**

Masaji et al or Yamakoshi et al do not disclose discrete impedance element.

Dible et al disclose connecting power to a plurality of electrodes through variable impedance elements which are feedback controlled according to detected power (Abstract and Fig 5).

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to adjust impedance elements to control power out put to antennas for precise control of spatial plasma densities.

**15. Claims 19-22 and 34-35 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Dible et al (US 6042686) and further in view of Nakamura et al (JP 2001094485).**

Masaji et al or Yamakoshi et al in view of Dible et al do not disclose pickup coil and bridge rectifier with a capacitor to measure power.

Nakamura et al disclose a pick-up coil and a rectifier to convert to DC disposed proximately to an antenna (Abstract and Fig 3).

Therefore it would have been obvious for one of ordinary skill in the art to measure power in the way taught by Nakamura et al in order to be able to control it precisely in the apparatus of Yamakoshi et al or Masaji et al.

**16. Claims 22 is also rejected under 35 U.S.C. 103(a) as being unpatentable over Masaji et al (JP 2001-035697) or Yamakoshi et al (US 2001/0021422) in view of Dible et al (US 6042686) and further in view of Koji Oku (JP 08162291).**

Masaji et al or Yamakoshi et al in view of Dible et al do not disclose a mixer for voltage and current signals to measure power.

Koji Oku disclose a high-frequency power source (Fig 1-10) comprising a matching box (30) and a power detection circuit (40), wherein the power detection circuit comprises a low pass filter (47) for conducting frequency mixing in double balanced mixers (46a, b) and removing the high-frequency components from the output of the double balanced mixers using local oscillator (45) and further low pass filter (49). Therefore power detection circuit converts the frequency of the high-frequency power to a low frequency and conducts detection based on the low-frequency power. Further the detected signal is used as negative feedback for control of high frequency power (Abstract and Fig 2).

Therefore it would have been obvious for one of ordinary skill in the art to measure power in the way taught by Koji Oku in order to be able to control it precisely in the apparatus of Yamakoshi et al or Masaji et al.

***Response to Arguments***

Applicant's arguments filed 12/22/2008 have been fully considered but they are not persuasive.

Applicant argues that Yamakoshi, Masaji et al or Koji et al fails to disclose a plate-shaped conductor that is connected to multiple RF antennas in parallel and arranged outside a vacuum chamber, as required by claim 5.

In response it is noted that the plate shaped conductor is disclosed at least by Yamakoshi (See 26a) and Kanda Minoru (2)

Further, Applicant argues that Yamakoshi, Masaji et al or Koji et al fails to disclose an impedance element connected to each of the RF antennas that regulates a current or voltage of each of the RF antennas as required by claims 13 and 34.

In response it is noted impedance element may only be a wire element. However discrete impedance elements for control are disclosed by Minoru Kanda or Majima Hiroshi, Choi et al and Dible et al.

Still further, Applicant argues that Masaji et al in view of Koji et al do not describe multiple RF antennas arranged substantially parallel to a stage with the vacuum chamber, where an aspect ratio of the RF antenna at a position corresponding to a target area of the stage is set at a value that is determined according to a plasma density or plasma electron energy desired for the target area, as required by claims 8 and 29.

In response, it is noted that Masaji et al discloses U shaped antennas protruding in to the chamber. It is obvious that their spatial location with respect to the plasma chamber would determine distribution of power coupling to the plasma and hence plasma density.

Still further, Applicant argues that Masaji et al in view of Koji et al do not describe adjacent electrodes of one or more pairs of adjacent RF antennas to have the same polarity, and the multiple RF antennas as substantially U-shaped as required by claims 11 and 32.

In response it is noted that U shaped antennas are disclosed at least by Masaji et al and Kanda Minoru. The polarity is related to how they are connected. Both Masaji and Kanda Minoru disclose symmetrical connections and therefore proper polarity.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ram N. Kackar whose telephone number is 571 272 1436. The examiner can normally be reached on M-F 8:00 A.M to 5:P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571 272 1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ram N Kackar/  
Primary Examiner, Art Unit 1792